



Social and economic benefits of weather-, climate- and water-related information and services

# MADRID CONFERENCE STATEMENT AND ACTION PLAN



**World  
Meteorological  
Organization**  
Weather • Climate • Water

Adopted by the International Conference on

**SECURE AND SUSTAINABLE LIVING:**  
Social and Economic Benefits of Weather, Climate and Water Services

Madrid, Spain, 19–22 March 2007

## WMO VISION

To provide world leadership in expertise and international cooperation in weather, climate, hydrology and water resources, and related environmental issues, and thereby to contribute to the safety and well-being of people throughout the world and to the economic benefit of all nations.

# MADRID CONFERENCE STATEMENT

The International Conference on Secure and Sustainable Living: Social and Economic Benefits of Weather, Climate and Water Services, organized by the World Meteorological Organization (WMO),<sup>1</sup> was held in Madrid, Spain, from 19 to 22 March 2007, under the gracious patronage of Her Majesty Queen Sofía. The Conference was hosted by the Environment Ministry and the National Meteorological Institute of Spain.

The Conference was attended by some 450 participants from 115 countries and consisted of an opening ceremony presided over by Her Majesty Queen Sofía, seven plenary sessions and seven main focus events. The opening ceremony was addressed by the Secretary-General and the President of WMO, a representative of the Ibero-American Secretariat, and the Minister of Environment of Spain. It included the launch by the WMO Secretary-General of the WMO book *Elements for Life*, which includes many case studies and examples of weather, climate and water services in support of poverty alleviation, disaster mitigation, climate change assessment, pollution abatement, water resources, energy and health management, and protection of the environment.

The purpose of the Conference was to contribute to secure and sustainable living for all the peoples of the world by evaluating and demonstrating, and hence ultimately enhancing, the social and economic benefits of weather, climate and water services. It sought to assemble authoritative feedback from the users of these services in order to:

- Inform governments and stakeholders generally of the immense societal benefits that flow from their investment in the global meteorological and hydrological infrastructure that supports the

<sup>1</sup> WMO is the United Nations specialized agency for weather, climate and water. It facilitates worldwide cooperation in the provision of meteorological, hydrological and related services and coordinates the international observation, research and service provision activities of the National Meteorological and Hydrological Services of its 188 Member States and Territories. WMO has a strong commitment to improve the quality and value of meteorological and related services and a long history of support for assessment and demonstration of the social and economic value of meteorological, hydrological and oceanographic data and services.

provision of meteorological and related services at the national level in every country;

- Foster increased awareness in both the current and potential user communities of the availability and value of the full range of existing, new and improved services;
- Initiate and promote new approaches to the evaluation of the social and economic benefits of meteorological and related services in the research, education and applications communities;
- Provide the basis for greatly strengthened national and international partnerships in the provision of meteorological, hydrological and related services;
- Guide the priorities of the National Meteorological and Hydrological Services (NMHSs) for infrastructure investment, service provision and service delivery.

Weather, climate, water and related phenomena have an impact on every member of society and every sector of the economy. Meteorological and hydrological influences and events profoundly affect the patterns of human settlement, the routine of daily life, the health of national economies and the quality of the natural environment. The most important meteorological, hydrological and related influences on society are as follows:

- Natural hazards and natural disasters (wildfires, storms, floods, droughts, hurricanes, blizzards, etc.);
- Weather (temperature, humidity, rainfall, wind, etc.);
- Climate (both short-term variability and long-term change);
- Air quality (smoke, chemicals, urban pollution, dust, etc.);

- Water (flood and drought, quality and quantity);
- Oceans (temperature, salinity, waves, currents, tsunamis, etc.).

No social or economic sector is immune from the impacts of weather, climate and water events. Virtually all sectors in almost every part of the world are extremely weather- and climate-sensitive on some or all time-scales. The six major socio-economic sectoral groups examined at the Conference were the following:

- Agriculture, water resources and the natural environment;
- Human health;
- Tourism and human welfare;
- Energy, transport and communications;
- Urban settlement and sustainable development;
- Economics and financial services.

Despite the current levels of service provision and the sophisticated disaster management arrangements that have been put in place in many countries, the global costs of weather-, climate- and water-related disasters may exceed 100 000 deaths and US\$ 100 billion of damage in a single year. Without the existing meteorological and related information and warning services, there is no doubt that these costs would be significantly higher.

The Conference reiterated that, among others, the role of NMHSs is to provide the information and services that enable governments and other stakeholders to minimize the costs of natural disasters, protect and strengthen the weather-, climate- and water-sensitive sectors of the economy, and contribute to the health, welfare and quality of life of the population. This role, among many, is carried out through the operation of the national meteorological and hydrological observation and data-processing

infrastructure. In many countries NMHSs, in partnership with academic and private sector service providers, provide a wide range of information and advisory services, including the following:

- Historical climate data and products;
- Current information (weather, climate, air quality, streamflow, etc.);
- Weather, climate, air quality, river and ocean forecasts;
- Warning services (for all forms of meteorological, hydrological and oceanographic hazards);
- Projections and scenarios of future human-induced climate change;
- Scientific advice and investigations.

The communication of this information to operators and custodians of diverse weather-, climate- and water-sensitive sectors enables them, through increasingly sophisticated decision methods and models, to take more informed decisions and deliver greatly improved outcomes compared with those that would be achievable without access to this information or use of these services.

The Conference reviewed a range of sector-specific decision-making techniques and case studies of increased use of weather, climate and water information and services leading to improved decisions and outcomes in the six key socio-economic sectoral groupings. Having evaluated a range of methodologies for assessing the value of, and benefits from, the use of the services, the Conference concluded that more work is required to further develop these socio-economic techniques and methods.

Each plenary session of the Conference consisted of a number of keynote addresses, presided over by a member of the International Steering Committee, followed by an extended debate and question period moderated by members of the International Association

of Broadcast Meteorology. Rapporteurs from the WMO Task Force on Socio-Economic Applications of Public Weather Services recorded the key conclusions from each session as the basis for the summary findings and proposed follow-up action set out below.

### **Agriculture, water resources and the natural environment**

The agriculture, water resources and environment sectors are probably the primary users of weather, climate and water information. In order to meet the food, fodder, fibre and renewable agri-energy needs of rapidly growing populations, especially in developing countries, information generated by the NMHSs is a vital element for ensuring the sustainable use of natural resources. Projections of climate change and climate variability have generated a growing sense of urgency for continued but closer collaboration between the users in the agriculture, water resources and environmental sectors and NMHSs. This collaborative process must move forward more aggressively, with possible flood and drought risk management or control, to maximize the benefits of weather, climate and water information in these sectors. Selected specific action items identified include the routine engagement by NMHSs of end-users and stakeholders in the development of products and services; improved communication and coordination in the development, use, assessment and improvement of these products; the development of a policy promoting free, unrestricted and timely exchange of data and information to foster stronger linkages with the different user sectors; and the development of partnerships between climate, water and environmental scientists to improve water management and water use efficiency in order to deal more effectively with weather- and climate-related events such as droughts and floods.

### **Human health**

There is clear evidence that environmental factors are key determinants of human health. In particular,

weather and climate parameters are crucially linked, both directly and indirectly, to a large number of health issues, such as vector-borne diseases, meningitis, malnutrition, cardiovascular and respiratory diseases, and skin cancer. Climate change will exacerbate these problems significantly in many parts of the world. A multidisciplinary understanding of the relevant issues, as well as the development of appropriate tools and end-to-end systems, is crucial for public health, sustainable development and poverty reduction. Selected specific action items identified include the following: undertake systematic analyses of the impacts of climate and weather anomalies on global public health; develop a baseline set of climate, epidemiological and socio-economic data at the district level, coupled with geographic information system tools for analysis; develop enhanced, scalable climate and health forecast models and warning systems that provide sufficient time for effective interventions to be made; carry out detailed cost-benefit analyses to strengthen the case for further investments, and develop performance indicators for determining the success of interventions; build capacity in health and meteorological services, as well as local community infrastructure for sustainable systems; develop collaborative linkages between weather, climate, public health and media personnel for enhanced integrated service delivery, which will facilitate the provision of consolidated health messages; provide communications and media training and education for health and meteorological specialists on delivery of climate and health information to policymakers and the public; build on the experience of the public broadcast media in delivering forecast and warning information; and provide high-frequency, high-resolution health-based weather forecasts tailored to specific health issues, as one-month, seasonal and longer-range forecasts have been identified as providing potential benefits to users.

### **Tourism and human welfare**

Tourism is a significant and rapidly growing sector of the world economy and one of the sectors most

sensitive to the influence of weather and climate. Many developing nations are critically dependent on tourism for economic development and poverty alleviation. The industry has benefited significantly from, and greatly appreciates, the improvement in the quality and reliability of weather and climate forecasts, including those of extreme events, and the greater lead time. It is recognized that climate change is a major challenge to the tourism industry, through both its direct impacts and efforts to reduce greenhouse gas emissions. Accurate and robust local climate information is urgently required for the planning and development of sustainable tourism facilities and management of the natural environment. There is significant scope for further collaboration between the meteorological/climatological community and the tourism industry to enhance safety through improved warnings of extreme events, to allow for more effective management of tourist facilities and for effective adaptation to the multiple impacts of climate variability and change.

### **Energy, transportation and communications**

Sound transport and energy management practices require NMHSs to focus on user requirements in data collection, analysis, research and development, transition of research and development to services, and education and outreach. All timescale forecasts are needed in the energy and transport sectors. The Conference noted the importance of user-oriented forecast services, for example climate change scenarios for energy and transportation infrastructure planning, and upper-level wind and temperature forecasts, which are particularly critical for long-haul aviation. Renewable energy, such as agri-energy, solar energy and wind, will help society to address the environment-, climate- and health-related greenhouse gas emission issues. It is necessary to reinforce a holistic marketing strategy and an institutional approach to adequately identify user requirements and to ensure that user needs are properly met through a proactive engagement during development, implementation,

assessment and improvement of such products and services.

### **Urban settlement and sustainable development**

Critical priority should be given to the urban ecosystem for targeted meteorological services, research, monitoring and translation of science into user-friendly decision-making tools. Corresponding infrastructure needs to improve in developing countries, with special attention to tropical regions. It is crucial to operationalize urban meteorology in combination with its environment. The synergetic solutions to urban and rural policy issues, ranging from productivity and migration to integration, should be taken into consideration. A multi-hazard early warning system should be developed in every region, city and neighbourhood using the concept of multi-hazard integration. The Conference recognized the importance of adaptation in the development agenda of developing countries, and for Africa, noted the importance of the Climate for Development in Africa Programme (ClimDev Africa) and that it is imperative that NMHSs be actively engaged in the implementation of this programme. WMO should further cooperate with organizations that are dedicated to forestry governance, land use, property rights mechanisms and carbon financing in risk management and support integrated programmes for Africa, and share the knowledge.

### **Economics and financial services**

Climate-related disasters are growing faster than all other natural disasters. The World Bank is changing its focus from being reactive and tactical to being proactive and strategic. This implies enhancing preparedness, mainstreaming disaster risk, and developing common policies and procedures. Sophisticated approaches to assessing the economic value of public weather and climate services have been developed, such as the willingness to pay. For example, studies carried out in 2006 suggest an average value of US\$ 109 per annum per household in the United States for

weather information. Furthermore, forecast improvements can increase this value. Estimated benefits can be used to justify infrastructural costs and forecast improvements. Approaches to risk assessment in the insurance industry are now very complex, but still need to encompass climate change scenarios, as many risk calculations based on historical data might be wrong. The effective protection of increasingly complex societies from natural hazards is a political imperative arising from the fundamental role of government. The approach needs to evolve from being reactive to being proactive, with the sciences of environmental prediction leading to informed choices and coherent planning. NMHSs need to gain some understanding of how end-users make decisions and what range of decisions they can make. The decision-making value chain encompasses the meteorological event, the forecast, the communication of the information, the making of a consequential decision, and the final outcomes of that decision.

### Regional perspectives

The discussion and information exchange at the Conference benefited greatly from the series of seven regional and subregional preparatory workshops organized by WMO during the period November 2005 to February 2007 in the Philippines, Mali, Brazil, Kenya, the United Republic of Tanzania, Kuwait and Croatia. The many sectoral and national case studies presented at these workshops, and the interaction they generated between provider and user communities, contributed greatly to the range and depth of the discussion at the Conference and to the achievement of its ultimate objectives.

The principal goal of the preparatory workshops was to provide a forum for promoting interdisciplinary assessment of socio-economic benefits of meteorological and hydrological services involving service providers and different users. The workshops identified common regional issues and specific national differences. The workshops highlighted the impacts of weather-, climate- and water-related phenomena on society as well as the usefulness of meteorological

and hydrological information and services provided by NMHSs. However, only in a few national cases was a quantitative evaluation made of the benefits of such services.

The workshops also noted the following:

- Inadequate understanding of user needs and requirements for meteorological and hydrological information and services by NMHSs;
- Lack of awareness of users of the available and potential weather, climate and water services in developing countries, in particular the least developed countries;
- The difficulty of integrating weather, climate and water services into national development strategies and priorities, including those related to the United Nations Millennium Development Goals;
- Lack of capacities and specialized competencies in NMHSs of developing countries to deliver timely and relevant services in order to better meet the needs of users;
- Inadequate communication between NMHSs and users.

The workshops made general and more focused recommendations as follows:

- To integrate the outcomes of the regional workshops into the various strategic plans of regional associations;
- To organize national workshops to define appropriate processes for quantitative evaluation of the socio-economic benefits of meteorological and related services, including the development and implementation of pilot demonstration projects and sharing good practices and experiences;
- To establish appropriate partnerships between various stakeholders, in particular providers and users;

- To organize capacity-building initiatives, including training both providers and users to facilitate better delivery of meteorological and related information and products;
- To develop the capacities of NMHSs in marketing and communication;
- To address emerging user needs, including climate change related issues.
- Indian research and demonstration of bamboo-based technologies for developing countries to cope with deforestation and climate-related extreme events;
- Progress in air-quality monitoring and modeling, and the benefits that flow from improved air-quality services, and the role the Global Atmosphere Watch Urban Research Meteorology and Environment project plays in enhancing the capabilities to address these issues;

The Conference agreed that NMHSs need to enhance their efforts to make potential users, including their governments, aware of the range of both available and potential new products and services, and their expected benefits for users. This should lead to a dialogue with users so that they can specify their requirements and respective service level agreements can be concluded.

- The perspective of NMHSs on the provision of timely and accurate weather, climate and water services;
- A series of important studies carried out by the World Bank on the economic benefits of modernizing the NMHSs of a number of Eastern European and Central Asian countries.

## Focus events

The seven focus events formed an integral part of the Conference as these complemented and elaborated many of the issues that emerged in the plenary discussions and regional workshops. In addition to the major focus event that reviewed the findings of the seven regional workshops and identified the common issues across regions, these events focused on the following:

- The developing role of the Global Earth Observation System of Systems in fostering increased coordination and interoperability among atmospheric, oceanic and terrestrial observing systems to support the delivery of information and services to nine major socio-economic benefit areas;
- Work by the United States National Aeronautics and Space Administration on the current realities and challenges of using remote sensing observation technologies for understanding and predicting hazardous natural disasters, and supporting decisions for reducing risks of disasters and managing natural resources;
- **Expressed their appreciation** to WMO and to the Government of Spain for organizing and hosting this landmark event;
- **Expressed appreciation also** to the keynote speakers, whose participation motivated the dialogue between participants;
- **Resolved to draw to the attention of decision-makers** everywhere, the large and growing impact of weather, climate and water influences

on community safety and well-being around the world, and the enormous potential benefits to be gained from improved and enhanced use of meteorological and hydrological services in decision-making in virtually every social and economic sector and every country;

- **Stressed** that much closer dialogue, partnerships and multidisciplinary understanding between providers and users of weather, climate and water services are essential to improved decision-making and delivery of social and economic benefits;
- **Urged WMO** to develop a follow-up implementation plan to the Conference to assist its Members in achieving the benefits which the deliberations of the Conference suggest are potentially available;
- **Encouraged NMHSs** to take the initiative at the national level, through outreach workshops and in other ways, in establishing improved consultation and partnership arrangements with their major user community groups and other stakeholders;
- **Encouraged** the academic social science community to work closely with the providers and users of meteorological and related services in developing applications and improving the methodologies for evaluating the societal benefits of meteorological and hydrological information and services;
- **Urged** those government agencies of Members, responsible for overall national social and economic development, to closely involve their NMHSs in identifying and enhancing the opportunities for achieving the benefits of national and international meteorological and hydrological services in the public interest;
- **Agreed**, therefore, to the following Madrid Action Plan to enhance the social and economic benefits of weather, climate and water information and services.

# MADRID ACTION PLAN

The overall objective of this Action Plan is to achieve, within five years, a major enhancement of the value to society of weather, climate and water information and services in response to the critical challenges represented by rapid urbanization, economic globalization, environmental degradation, natural hazards, and the threats from climate change.

**Action 1:** Review the institutional framework governing meteorological and hydrological service provision in order to strengthen partnerships with different sectors of the economy.

**Action 2:** Lead a quantum change in the way that weather, climate and water information and services are produced, used and communicated by identifying, confirming and responding to the rapidly increasing and evolving needs of multidisciplinary stakeholders for appropriately timed and scaled weather, climate and water information and services.

**Action 3:** Embark on capacity-building endeavours through the creation of education and training opportunities for both users and providers of weather, climate and water information in order to increase awareness of users to the opportunities afforded by weather, climate and water services, and to assist the providers of these services to understand more fully user requirements.

**Action 4:** Foster increased recognition by governments and other stakeholders of the contribution that National Meteorological and Hydrological Services (NMHSs) and their partners are making to secure and sustainable living.

**Action 5:** Adopt the following steps to meet the growing demand for weather, climate, water and related information and services:

- Strengthening of observational programmes, and the associated research and development;
- Development of the next generation of climate and Earth system models with resolutions of

10 km or finer, and the corresponding data assimilation systems;

- Significantly strengthening multidisciplinary research programmes required to develop the understanding underpinning the development of these models;
- Improving delivery and distribution systems, including early warning systems, to allow NMHSs to meet the needs of institutions, agencies and the general public; consolidating existing and, when appropriate, creating new regional operational centres to mutualize competencies and resources.

**Action 6:** Develop analysis of the urban environment as a critical ecosystem requiring targeted observation, research, and meteorological and hydrological services.

**Action 7:** Facilitate and strengthen dialogue and collaboration between providers and users of weather, climate and water information and services through international, regional and national platforms and programmes, and through the development of appropriate tools and methods.

**Action 8:** Strengthen existing, and develop and implement new, multidisciplinary programmes that will define and improve ways and means to generate and deliver those weather, climate and water services, which address the developmental, societal, economic, environmental and health concerns of the countries.

**Action 9:** Strengthen existing, and establish new, operating partnerships between users and providers of weather, climate and water services to share responsibility for effective delivery of services, and evaluate their performance.

**Action 10:** Facilitate and strengthen the ability of NMHSs to effectively communicate weather services and products, through all forms of media, in such

a manner as to maximize the benefits provided to society by the meteorological and hydrological community.

**Action 11:** Encourage the NMHSs and the social science research community to develop knowledge and methodologies for quantifying the benefits of the services provided by NMHSs within the various socio-economic sectors, in particular:

- Develop new economic assessment techniques including especially techniques of economic assessments for developing and least developed countries;
- Develop WMO guidelines on operational use of economic assessment techniques;
- Train national staff on the use and practical application of economic assessment of the benefits of services provided by NMHSs;
- Present results of economic assessments to governments and donors or international financial institutions with the goal of modernizing the infrastructure of NMHSs and strengthening their service delivery capacity.

**Action 12:** Encourage the free and unrestricted exchange of meteorological, hydrological and related data to support research and improve operational services.

**Action 13:** Build on the earlier WMO work on the development of a comprehensive economic framework for meteorological service provision.

**Action 14:** Develop, as a matter of urgency, the implementation plan to give effect to the actions set out above.

**Action 15:** Monitor and report every year to key partners on progress with the implementation plan, and organize a further, more broadly based, conference in five years to take stock of achievements under this Action Plan.

The World Meteorological Organization is an intergovernmental organization with a membership of 188 Member States and Territories. In the United Nations system, it is the authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources in the world. WMO's Headquarters are in Geneva, Switzerland.

WMO coordinates the activities of its Members in the generation and exchange of information on weather, water and climate according to internationally agreed standards; research at the national, international and global levels; and the training of professionals to internationally recognized levels. WMO also facilitates the development of services that improve the well-being and safety of communities, nations and the whole of humankind.

